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in Art, Music, and Science

"Moorish Fretwork"

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Abstract

This paper discusses the 19th century woodwork of Moses Younglove Ransom who invented a method of milling spiral rods that could be woven together in geometric lattice screens that were used as decorative panels in architectural work and furniture. He discovered that these spiral rods could be used to construct a hyperbolic ring which he then incorporated into some of his furniture.

On September 15, 1885 a design patent (Figure 13) was issued to Moses Younglove Ransom for building lattice type screens from milled spiral rods [1]. A year earlier, Ransom, from Cleveland, Ohio, received a patent for a lathe feed mechanism with which he made these spiral rods [2]. Moses Ransom called his invention "Moorish Fretwork" for its obvious similarity in appearance to the mashrabiyya (Figure 1) screens found throughout the Middle East. The Moorish moniker made the screens have a more exotic sounding pedigree. The geometries in the screens share much of the tessellation geometries of tile work (Figure 2) found in ornamental tile decoration of the Moorish architecture in Spain. This eastern influence on American art and architecture reached its height in the late 1880's and early 1890's and is commonly known as the Orientalism period of the Aesthetic movement in furniture design and architecture.

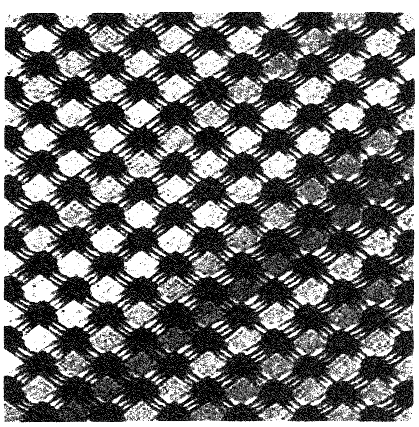

Figure 1: Arabic mashrabiyya [3]

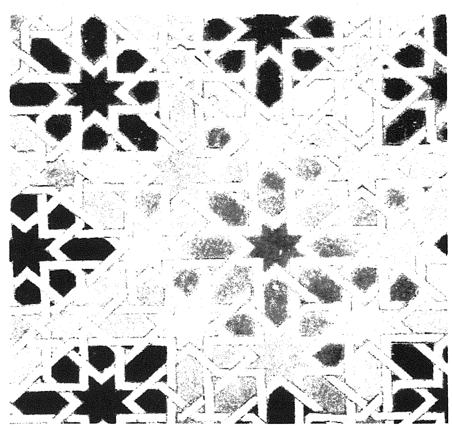

Figure 2: Moorish tile pattern [4]

Ransom used two different kinds of rods in his "Moorish Fretwork" screens. The first type can be mathematically described as the envelope of a sphere rotating around a line it is tangentially traveling along. In the early 1800's French mathematician, Gaspard Monge, was the first to explore the mathematics of this shape. Monge, the founder of "descriptive geometry", called them "Helical Canal Surfaces". The second looks like an auger-type drill bit. Both right-handed and left-handed spiral rods are necessary for most of his designs. In the accompanying copy of Ransom's patent, you can see both types intertwined at the top of the cover page. Just below that is the first type (referred to as a regular Ransom Spiral) and then below that the second type (Ransom's Auger Spiral). The bottom half of the page shows a half dozen possible designs using these spiral rods.

Of these designs, the panel labeled C is a closed (with no skips) perpendicular screen made with a right-hand Auger Spiral in the vertical positions and a left-hand Auger Spiral in the horizontal positions. This is a very tight weave that leaves very little open space. The process to construct the simplest perpendicular woven lattice would have been to first lay out a number of same-handed rods parallel on a flat table and then screw opposite-handed rods perpendicular to the field of rods on the table.

Panel D is essentially the same thing as panel C except that regular Ransom Spirals have been substituted in every other position, alternating between the two types. All the spirals maintain the same-handedness as in C.

Panel E represents the non-perpendicular lattice possibilities. It is also a closed screen with opposite-handed regular Ransom Spirals but in this case the pitch of the spiral rods has been lengthened to allow some movement in the lattice. This oblique orientation allowed for some very interesting 3-dimensional constructions in Ransom's furniture work.

Panel H is probably the most common weave pattern that Ransom used. In both advertisements (Figure 3) and in extant pieces of Ransom's work (Figure 4) this design seems to be the most popular. By skipping every third rod Ransom opened up the lattice without losing the strength of the woven design.

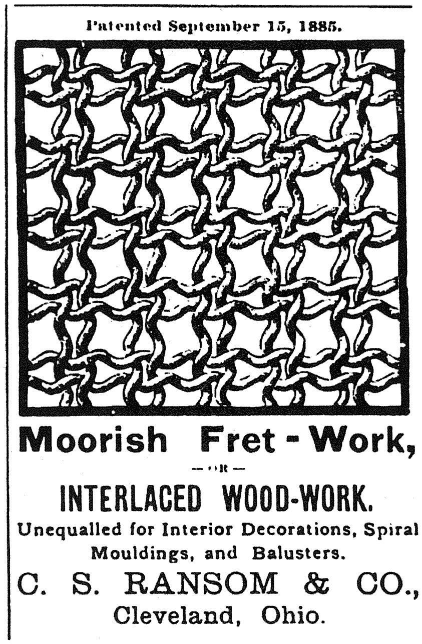

Figure 3: Ransom ad [5]

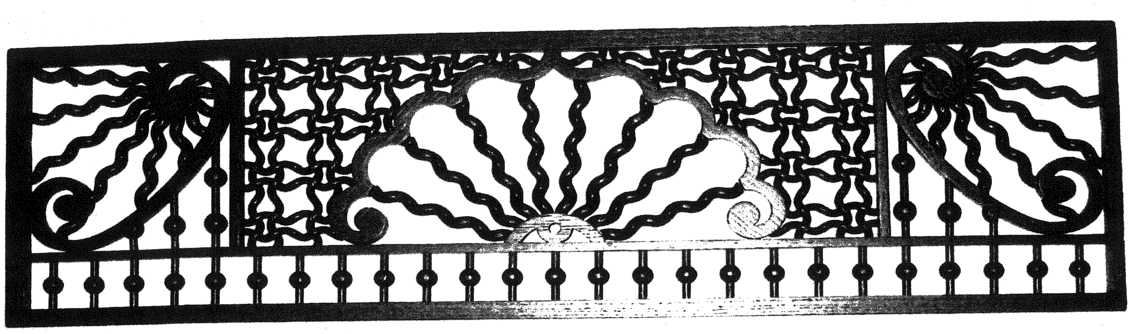

Figure 4: Note the careful symmetry of Moses Ransom's Moorish Fretwork screens [6]

Although Ransom advertised that he could do this work as small as a pencil's diameter and up to 6", the only two sizes that I have found in pictures or in actual pieces are either 7/16" or 7/8" in diameter and either 1½" or 2" pitch. The diameter refers to the size of the stock that the spiral would need to be milled out of. For instance the 7/8"-2" pitch regular Ransom Spiral would be generated by a 7/16" sphere rotating tangentially around a line making one full revolution every 2" of lateral movement along the line.

Figure 5: Merklen Brothers chair with Moorish Fretwork [7]

Made in England during the 1800's, "barley twist" was a popular candy made by rolling barley flavored sugar candy into a long slender rope, which was folded in half and twisted together. The well-known shape of this popular confection led to the adoption of its name in furniture making. The dictates of fashion made the quick and inexpensive manufacture of spiral woodwork an interesting and possibly lucrative problem to solve. The removal of one of the strands leaves a hollow or "open barley twist". This very fragile open twist work, though, could not be done on a traditional lathe like most spiral work of the time. In the last half of the 19th century there were over 50 patents filed for machines that could mass-produce spiral work. Only a few of these machines were capable of doing this "open barley twist" work that was used in Ransom's Moorish Fretwork.

The Merklen Brothers spiral furniture manufacturing company in New York City used Ransom's Moorish Fretwork extensively in their chairs (Figure 5) and other furniture accessories. Their automatic spiral-molding machine (Figure 6) is an ingenious work of elegant simplicity. Once a dowel rod was secured in the jaws of the chuck, a single lever could engage the drive and cutter mechanisms and then shut itself off after completing the job. The operator could simply remove the finished piece, secure a new blank, and throw the start lever to repeat the process. Once the dowel is fastened to the drive rod with the chuck, it will advance into the cutter at the identical pitch of the milled groove in the drive rod. This particular machine imparts the rotational and longitudinal movement into the workpiece advancing it past a stationary rotary cutter. The key to the success of these open twist machines was the support of the very fragile piece during and after the milling process.

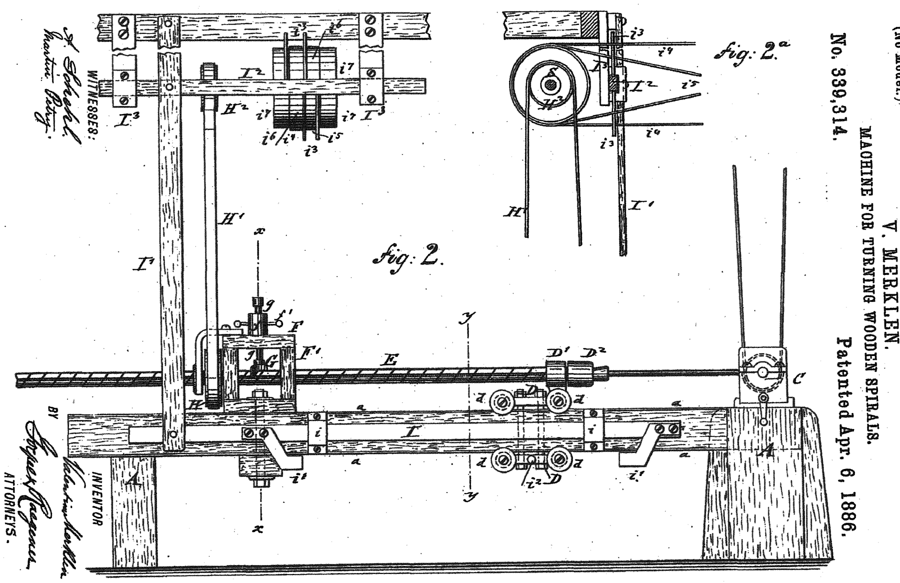

Figure 6: Patent drawing for automatic twist machine by Valentine Merklen [8]

The most interesting aspect of Ransom's work is found in some of his furniture work. Ransom discovered that an obliquely oriented lattice could be wrapped around on itself to form a section of a hyperboloid. Figure 7 shows one of Ransom's umbrella stands with such a hyperbolic ring at the top. Rinus Roelofs, using the Rhinoceros NURBS 3d modeling program recreated, the top ring of Ransom's umbrella stand in Figure 8. Because the hyperboloid of one sheet is a doubly ruled surface (the surface can be covered by two different sets of intersecting straight lines) his spiral rods do not need to be bent to make this shape. The construction sketch in Figure 9 illustrates this principle. The only other doubly ruled surfaces are the plane and the

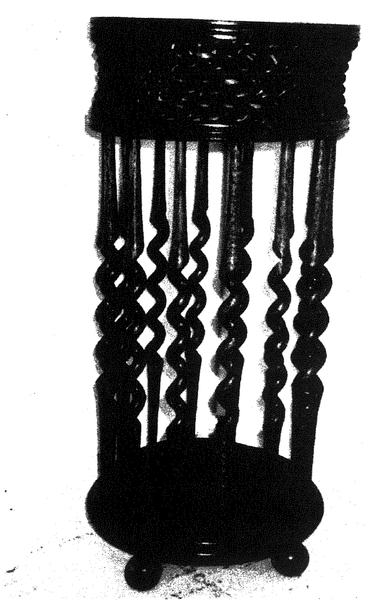

Figure 7: Umbrella stand [9]

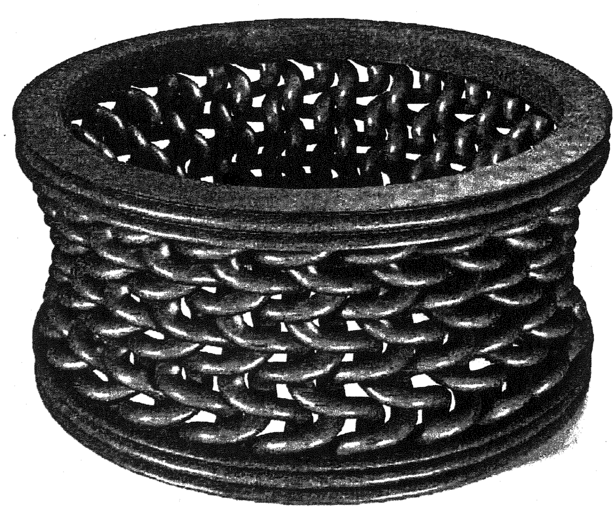

Figure 8: Digital recreation of hyperbolic ring [10]

hyperbolic paraboloid. Although Ransom used the doubly ruled properties of planes and hyperboloids of one sheet there is no evidence that he used them in the saddle shaped hyperbolic paraboloid. Ransom did make some of his screens into cylindrical sections using a steam bending process but the vast majority of his work utilized only the straight spiral rods.

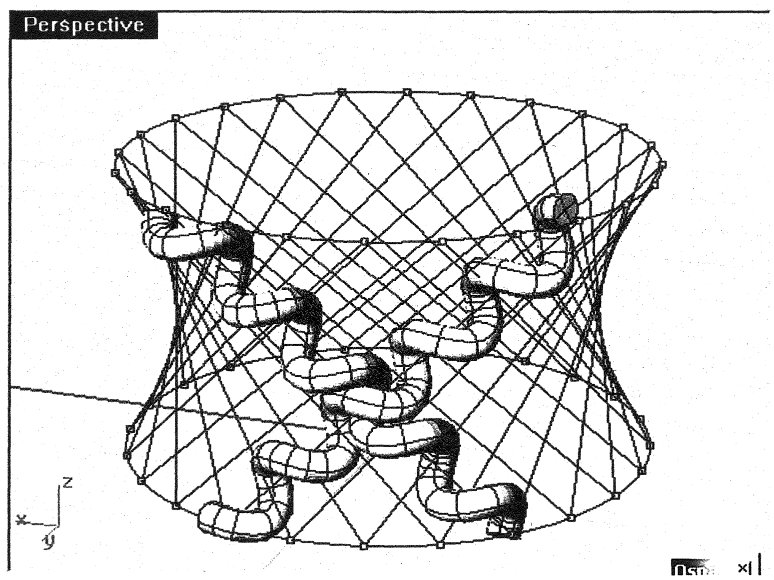

Figure 9: Framework illustrating doubly ruled hyperbolic surface [11].

A century's worth of dust and forgetfulness have recently been brushed off this fascinating and unique type of woodworking. In addition to new pieces being manufactured, some exploration into new weaving patterns has begun. Dutch sculptor, Rinus Roelofs, has modeled many of Ransom's original patterns (Figure 10) using Rhinoceros 3d software tools.

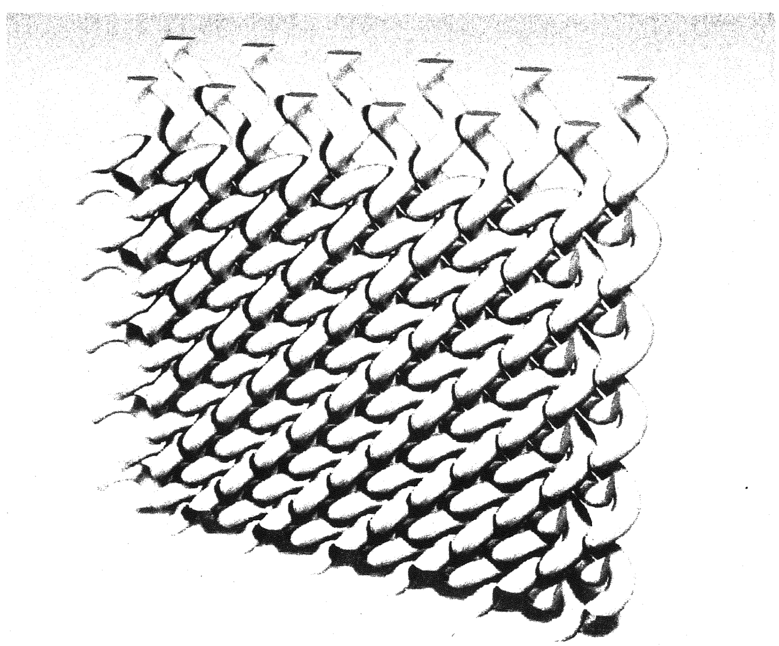

Figure 10: Rendering of original Ransom Moorish Fretwork pattern [12]

Roelofs has also modeled the third doubly ruled surface, the hyperbolic paraboloid (Figure 11) and discovered the completely new hexagonal Moorish Fretwork pattern (Figure 12). The hexagonal pattern uses all same-handed spiral rods and is actually closer to a true Moorish design although there is no evidence that Moses Ransom or the Merklen brothers, the two chief manufacturers of Moorish Fretwork, ever attempted or conceived of this design.

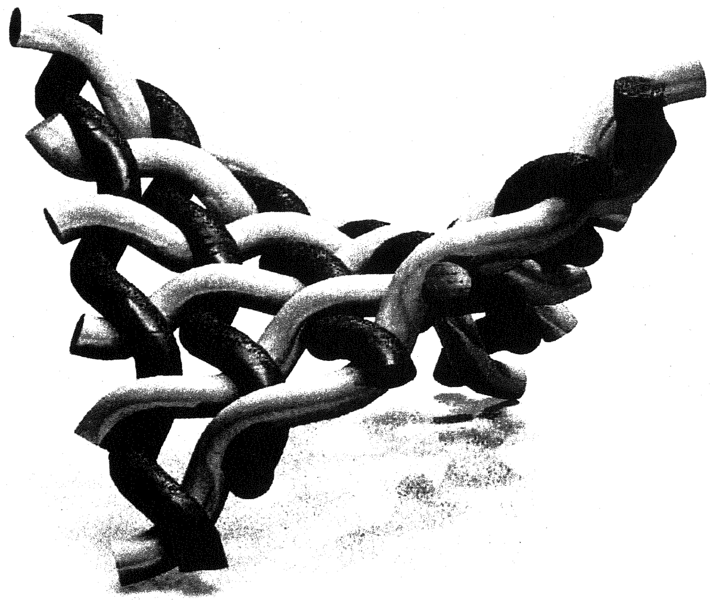

Figure 11: Moorish Fretwork hyperbolic paraboloid [13]

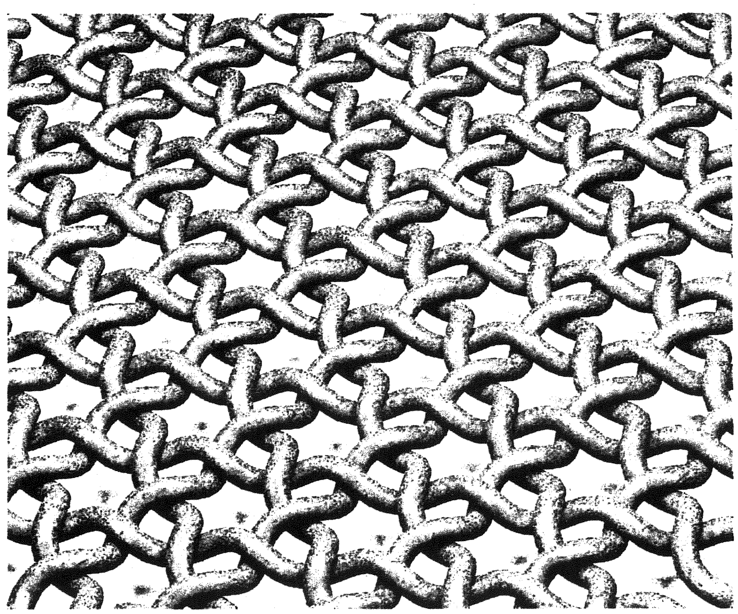

Figure 12: Hexagonal Moorish Fretwork [14]

References

[1] U.S. Patent # 326,329
[2] U.S. Patent # 307,322
[3] Mashrabiyya screen from 2003 catalog by Dar Alandalus, Cairo, Egypt.
[4] Detail of tile work at Alhambra from souvenir guidebook.
[5] Advertisement in *American Architect and Building News*, March 20, 1886.
[6] Photo by author.
[7] Photo by Bruce Cummings, Courtesy of Southampton Antiques, Southampton, MA, 2003
[8] U.S. Patent # 339,314
[9] Photo by author.
[10] Rinus Roelofs 2003
[11] Rinus Roelofs 2003
[12] Rinus Roelofs 2003
[13] Rinus Roelofs 2003
[14] Rinus Roelofs 2003

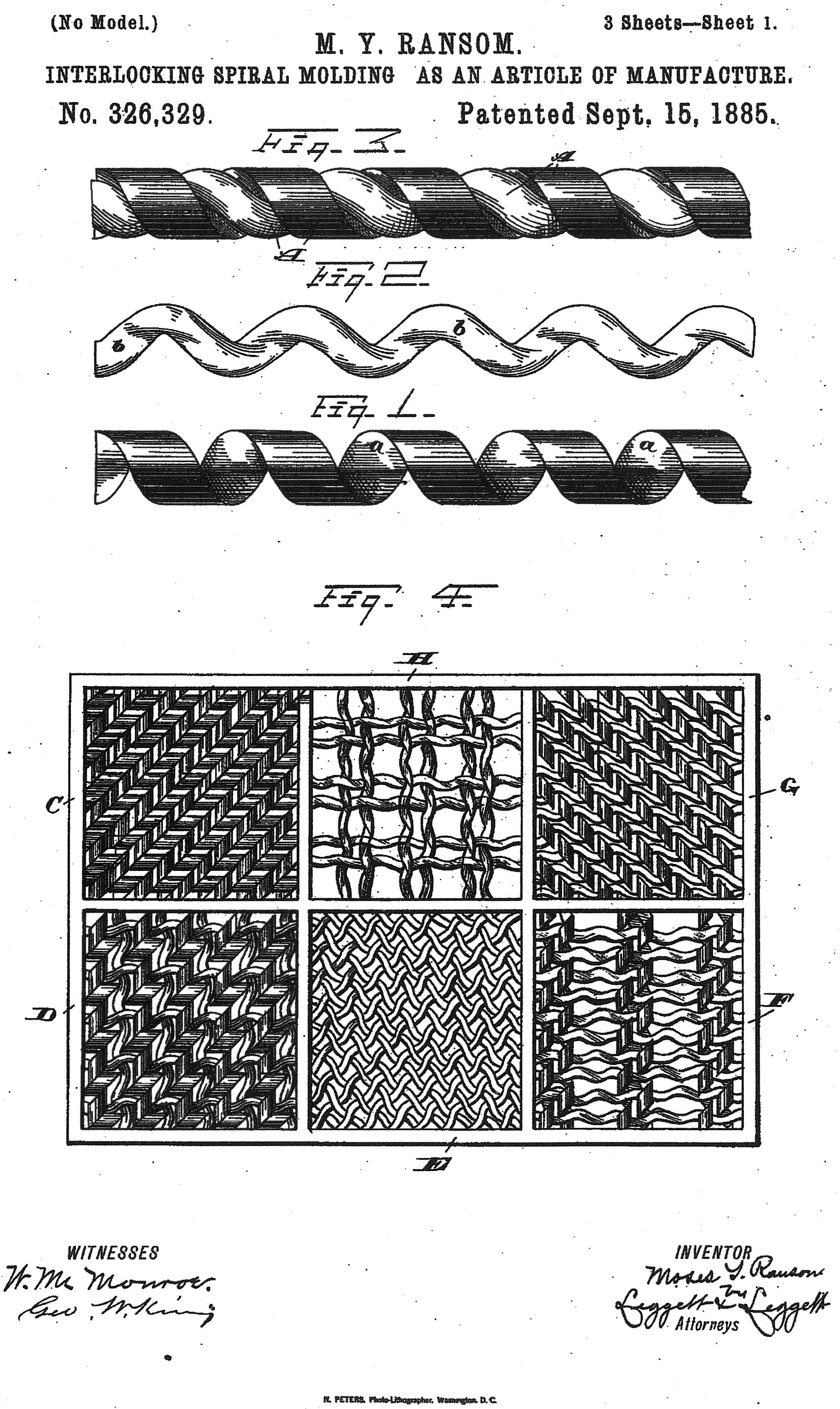

Figure 13: Moses Ransom's 1885 Moorish Fretwork design patent.